

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 510468 MDA/mjw	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. PCT/NZ2004/000331	International filing date (<i>day/month/year</i>) 23 December 2004	Priority date (<i>day/month/year</i>) 23 December 2003
International Patent Classification (IPC) or national classification and IPC Int. Cl.⁷ G06F 17/60		
Applicant REDMAYNE, John		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (sent to the applicant and to the International Bureau) a total of 7 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:

<input checked="" type="checkbox"/>	Box No. I	Basis of the report
<input type="checkbox"/>	Box No. II	Priority
<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input checked="" type="checkbox"/>	Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/>	Box No. VI	Certain documents cited
<input type="checkbox"/>	Box No. VII	Certain defects in the international application
<input type="checkbox"/>	Box No. VIII	Certain observations on the international application

Date of submission of the demand 21 October 2005	Date of completion of the report 18 November 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer MATTHEW HOLLINGWORTH Telephone No. (02) 6283 2024

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NZ2004/000331

Box No. I **Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1 (b))
- ☐ publication of the international application (under Rule 12.4)
- ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):
- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages **1-6, 8-39** as originally filed/furnished
- pages* **7** received by this Authority on **21 October 2005** with the letter of **the same date**
- pages* received by this Authority on with the letter of
- ☒ the claims:
- pages **40-50, 53-65, 68-79, 82-83** as originally filed/furnished
- pages* as amended (together with any statement) under Article 19
- pages* **51-52, 66-67, 80-81** received by this Authority on **21 October 2005** with the letter of **same**
- pages* received by this Authority on with the letter of
- ☒ the drawings:
- pages **1-8** as originally filed/furnished
- pages* received by this Authority on with the letter of
- pages* received by this Authority on with the letter of
- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to the sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to the sequence listing (*specify*):

* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. IV Lack of unity of invention

1. ☐ In response to the invitation to restrict or pay additional fees the applicant has:
- ☐ restricted the claims.
 - ☐ paid additional fees.
 - ☐ paid additional fees under protest.
 - ☐ neither restricted nor paid additional fees.
2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is:
- ☐ complied with.
 - ☒ not complied with for the following reasons:

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are two inventions:

1. Independent claims 1, 13, 52, 58, 60, 64, 95, 103, 109, 115 and 146. The correlating of two securities associated with an underlying asset is considered to be a first "special technical feature."
2. Independent claims 44, 95 and 146. The solution of an option-theoretic model for user-specified parameters is a second "special technical feature."

Since the abovementioned groups of claims do not share any technical features, a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly, the international application does not relate to one invention or to a single inventive concept.

4. Consequently, this report has been established in respect of the following parts of the international application:
- ☒ all parts.
 - ☐ the parts relating to claims Nos.

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/NZ2004/000331

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1-164	YES
	Claims	NO
Inventive step (IS)	Claims 1-164	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-164	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

- D1: WO 2003/034297 A1 (SUPERDERIVATIVES, INC.), 24 April 2003
- D2: US 2003/0139993 A1 (FEUERVERGER), 24 July 2003
- D3: US 2001/0056392 A1 (DAUGHTERY, II), 27 December 2001
- D4: US 2002/0065755 A1 (SHLAFMNA et al), 30 May 2002
- D5: WO 2001/052121 A2 (CANADIAN IMPERIAL BANK OF COMMERCE), 19 July 2001
- D6: WO 2003/107137 A2 (KONGTCHEU), 24 December 2003
- D7: US 2004/0064393 A1 (LUENBERGER), 1 April 2004
- D8: US 2004/0039673 A1 (AMBERSON et al), 26 February 2004)

The features of the claims do not appear to be published in the above documents, which represent the closest available prior art.

DETAILED DESCRIPTION OF INVENTION

The method and apparatus comprises a number of steps carried out by a computer. Several of these steps are novel and their application results in commercially useful, unified models. A key benefit is that the use of a single, unified and coherent approach leads to reductions in the amount of data and range of different models required in order to analyse different securities or assets. These reductions can provide significant savings in terms of the computer resources required by users. Particular embodiments of the invention are also provided.

Preferred embodiments and applications of the invention will now be described with reference to Figures 5 to 9. Other embodiments may be realised and structural or logical changes may be made to the disclosed embodiments without departing from the spirit or scope of the invention.

In a preferred embodiment, the invention is implemented in a financial instrument engine 100, as shown in Figure 5, used to analyse financial and economic signals provided by the financial markets and, based upon user input data and commands, issue position statements or reports for use by the user (or other components or systems), as well as issuing control signals for use by automated systems to effect positions (e.g., increase, decrease, change, etc.) held by the user in the financial markets. The financial engine 100 may be a stand-alone computer hardware system, incorporated in (or distributed among) one or more locally or remotely located computer systems.

In a preferred embodiment, financial engine 100 is composed of a plurality of modules: data source 10, risk analysis unit 12, risk pricing unit 13, financial instrument controller 15, financial modelling unit 16, and user interface device 17. In the illustrated embodiment, the modules are connected by a single transmission bus 14. (It should be understood that the illustration of bus 14 is merely representative of the various connectivity technologies available to those of ordinary skill in the art including single/multiple, wired, wireless, fibre optic and other transmission mediums.)

r_V is the rate of return on the firm's assets, per annum

y is the promised yield on the firm's debt, per annum

$$d_1 = \left(\left[\ln\left(\frac{V_0}{X}\right) + r_V T \right] / \sigma_V \sqrt{T} \right) + (1/2)(\sigma_V \sqrt{T})$$

$$d_2 = d_1 - \sigma_V \sqrt{T}$$

5 $N(\cdot)$ is the cumulative probability of the standard normal distribution with d_1 or d_2 as the upper limit

r is the risk free rate of return, per annum

σ_V is the standard deviation of rates of return on the firm's assets, per annum

σ_B is the standard deviation of rates of return on the firm's debt, per annum

10 σ_S is the standard deviation of rates of return on the firm's equity, per annum.

44. A computer implemented method for applying an option-theoretic model of a firm comprising the steps of generating one or more risk parameters from the model, estimated over a discrete time period, and solving the model so that the said parameters
15 equal values specified by a user.

45. The computer implemented method of claim 44, wherein one of the said risk parameters is a statistical moment of the returns of one or more of the securities issued by, or referenced to, the firm.

20

46. The computer implemented method of claim 44, wherein one of the said risk parameters is the correlation between the returns of a pair of securities issued by, or referenced to, the firm.

25 47. The computer implemented method of claim 44, wherein one of the said risk parameters is the covariance between the returns of a pair of securities issued by, or referenced to, the firm.

30 48. The computer implemented method of claim 44, wherein one of the said risk parameters is the correlation between the returns of a security issued by, or referenced to, the firm and the returns of the total firm.

49. The computer implemented method of claim 44, wherein one of the said risk parameters is the covariance between the returns of a security issued by, or referenced to, the firm and the returns of the total firm.

5

50. The computer implemented method of any one of claims 19 to 22, claim 30 or claims 41 to 49, wherein the formula for calculating additional parameters, being instantaneous volatility, for calibration with the model comprise:

$$\sigma_B = \sigma_V \frac{V_0}{B_0} e^{(r_V - r_B)T} [1 - N(d_1)]$$

10
$$\sigma_S = \sigma_V \frac{V_0}{S_0} e^{(r_V - r_S)T} N(d_1)$$

51. The computer implemented method of any one of claims 19 to 22, claims 30 to 34, or claims 41 to 49, wherein the formula for calculating additional parameters, being discrete time volatility, correlation and covariance, for calibration with the model
15 comprise:

$$\sigma_B = \sqrt{\ln \left(\frac{V_T^2 [1 - N(d_2)] e^{\sigma_V^2 T} + X^2 N(d_2)}{B_T^2} \right) / T}$$

$$d_2 = d_1 - \sigma_V \sqrt{T}$$

$N(\cdot)$ is the cumulative probability of the standard normal distribution with d_1 or d_2 as the upper limit

r is the risk free rate of return, per annum

5 σ_V is the standard deviation of rates of return on the firm's assets, per annum

σ_B is the standard deviation of rates of return on the firm's debt, per annum

σ_S is the standard deviation of rates of return on the firm's equity, per annum.

10 95. A system for applying an option-theoretic model of a firm, the system comprising:

a computer-readable memory;

a processing unit operative to generate one or more risk parameters from the said option-theoretic model, estimated over a discrete time period, and solve the model so that the said parameters equal values specified by a user.

15

96. The computer system of claim 95, wherein the processing unit is further operative to use as one of the said risk parameters a statistical moment of the returns of one or more of the securities issued by, or referenced to, the firm.

20

97. The computer system of claim 95, wherein the processing unit is further operative to use as one of the said risk parameters the correlation between the returns of a pair of securities issued by, or referenced to, the firm.

25

98. The computer system of claim 95, wherein the processing unit is further operative to use as one of the said risk parameters the covariance between the returns of a pair of securities issued by, or referenced to, the firm.

30

99. The computer system of claim 95, wherein the processing unit is further operative to use as one of the said risk parameters the correlation between the returns of a security issued by, or referenced to, the firm and the returns of the total firm.

100. The computer system of claim 95, wherein the processing unit is further operative to use as one of the said risk parameters the covariance between the returns of a security issued by, or referenced to, the firm and the returns of the total firm.

5 101. The computer system of any one of claims 70 to 73, claim 81 or claims 92 to 100, wherein the processing unit is further operative to use formula for calculating additional parameters, being instantaneous volatility, for calibration with the model, said formula comprising:

$$\sigma_B = \sigma_V \frac{V_0}{B_0} e^{(r_f - r_B)T} [1 - N(d_1)]$$

10
$$\sigma_S = \sigma_V \frac{V_0}{S_0} e^{(r_f - r_S)T} N(d_1)$$

102. The computer system of any one of claims 70 to 73, claims 81 to 85, or claims 92 to 100, wherein the processing unit is further operative to use formula for calculating additional parameters, being discrete time volatility, correlation and covariance, for calibration with the model, said formula comprising:

$$\sigma_B = \sqrt{\ln \left(\frac{V_T^2 [1 - N(d_3)] e^{\sigma_B^2 T} + X^2 N(d_2)}{B_T^2} \right) / T}$$

r_v is the rate of return on the firm's assets, per annum

y is the promised yield on the firm's debt, per annum

$$d_1 = \left(\left[\ln \left(\frac{V_0}{X} \right) + r_v T \right] / \sigma_v \sqrt{T} \right) + (1/2) (\sigma_v \sqrt{T})$$

$$d_2 = d_1 - \sigma_v \sqrt{T}$$

5 $N(\cdot)$ is the cumulative probability of the standard normal distribution with d_1 or d_2 as the upper limit

r is the risk free rate of return, per annum

σ_v is the standard deviation of rates of return on the firm's assets, per annum

σ_B is the standard deviation of rates of return on the firm's debt, per annum

10 σ_S is the standard deviation of rates of return on the firm's equity, per annum.

146. A computer readable medium having computer-executable instructions for performing a method to apply an option-theoretic model of a firm, said method comprising the steps of generating one or more risk parameters from the model,
15 estimated over a discrete time period, and solving the model so that the said parameters equal values specified by a user.

147. The computer-readable medium of claim 146, wherein one of the said risk parameters analysed by the computer-executable instructions is a statistical moment of
20 the returns of one or more of the securities issued by, or referenced to, the firm.

148. The computer-readable medium of claim 146, wherein one of the said risk parameters analysed by the computer-executable instructions is the correlation between
25 the returns of a pair of securities issued by, or referenced to, the firm.

149. The computer-readable medium of claim 146, wherein one of the said risk parameters analysed by the computer-executable instructions is the covariance between
the returns of a pair of securities issued by, or referenced to, the firm.

30 150. The computer-readable medium of claim 146, wherein one of the said risk parameters analysed by the computer-executable instructions is the correlation between

the returns of a security issued by, or referenced to, the firm and the returns of the total firm.

151. The computer-readable medium of claim 146, wherein one of the said risk
5 parameters analysed by the computer-executable instructions is the covariance between the returns of a security issued by, or referenced to, the firm and the returns of the total firm.

152. The computer-readable medium of any one of claims 121 to 124, claim 132 or
10 claims 143 to 151, wherein the computer-executable instructions use formula for calculating additional parameters, being instantaneous volatility, for calibration with the model, said formula comprising:

$$\sigma_B = \sigma_V \frac{V_0}{B_0} e^{(r_f - r_s)T} [1 - N(d_1)]$$

$$\sigma_S = \sigma_V \frac{V_0}{S_0} e^{(r_f - r_s)T} N(d_1)$$

15

153. The computer-readable medium of any one of claims 121 to 124, claims 132 to
136, or claims 143 to 151, wherein the computer-executable instructions use formula for calculating additional parameters, being discrete time volatility, correlation and covariance, for calibration with the model, said formula comprising:

20

$$\sigma_B = \sqrt{\ln \left(\frac{V_T^2 [1 - N(d_3)] e^{\sigma_V^2 T} + X^2 N(d_2)}{B_T^2} \right) / T}$$